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**REPORT FOR CONSULTATION ON THE  
LOUISVILLE  
INTERSTATE AIR QUALITY CONTROL REGION  
(INDIANA - KENTUCKY)**

**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
Public Health Service  
Consumer Protection and Environmental Health Service**

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OCTOBER, 1969

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## TABLE OF CONTENTS

|                                        | <u>Page</u> |
|----------------------------------------|-------------|
| Preface .....                          | 3           |
| Introduction .....                     | 5           |
| Evaluation of Urban Factors .....      | 14          |
| Summary .....                          | 25          |
| Evaluation of Engineering Factors .... | 27          |
| Summary .....                          | 46          |
| Proposal .....                         | 47          |
| Discussion of Proposal .....           | 47          |
| References .....                       | 51          |

**Preceding page blank****PREFACE**

The Secretary, Department of Health, Education, and Welfare, is directed by the Clean Air Act, as amended, to designate "air quality control regions" as an initial step toward the establishment of programs for regional management of air quality. In addition to listing the major factors to be considered in the development of region boundaries, the Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities.

The National Air Pollution Control Administration, DHEW, has conducted a study of the Louisville area, the results of which are presented in this report. The Region<sup>\*</sup> boundaries proposed in this report reflect consideration of available and pertinent data; however, the boundaries remain subject to revisions suggested during consultation with State and local authorities. This report is intended to serve as background material for the consultation. Formal designation of a Region will follow the consultation meeting.

The Administration appreciates assistance received either directly during the course of this study or indirectly during previous activities in the Louisville area from official air

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<sup>\*</sup>For the purposes of this report, the word "region", when capitalized, will refer to the Louisville Interstate Air Quality Control Region. When not capitalized, unless otherwise noted, it will refer to air quality control regions in general.

pollution control agencies at the State and local level, the Falls  
of the Ohio Metropolitan Council of Governments, and the University  
of Kentucky,

### INTRODUCTION

"For the purpose of establishing ambient air quality standards pursuant to section 108, and for administrative and other purposes, the Secretary, after consultation with appropriate State and local authorities shall, to the extent feasible, within 18 months after the date of enactment of the Air Quality Act of 1967 designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may from time to time thereafter, as he determines necessary to protect the public health and welfare and after consultation with appropriate State and local authorities, revise the designation of such regions and designate additional air quality control regions. The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Section 107(a)(2), Clean Air Act, as amended.

### THE REGIONAL APPROACH

Air pollution in most of the Nation's urban areas is a regional problem which frequently extends across a number of state and local governmental jurisdictions. This regional problem demands a regional solution, consisting of coordinated planning, data gathering, standard setting, and enforcement. Yet, with few exceptions, such coordinated efforts are notably absent among the Nation's urban complexes.

Beginning with the Section quoted above, in which the Secretary is required to designate air quality control regions, the Clean Air Act provides a regional approach to air pollution control involving coordinated efforts by Federal, State, and local governments.

Figure 1 is a flow diagram of this approach. The process is initiated

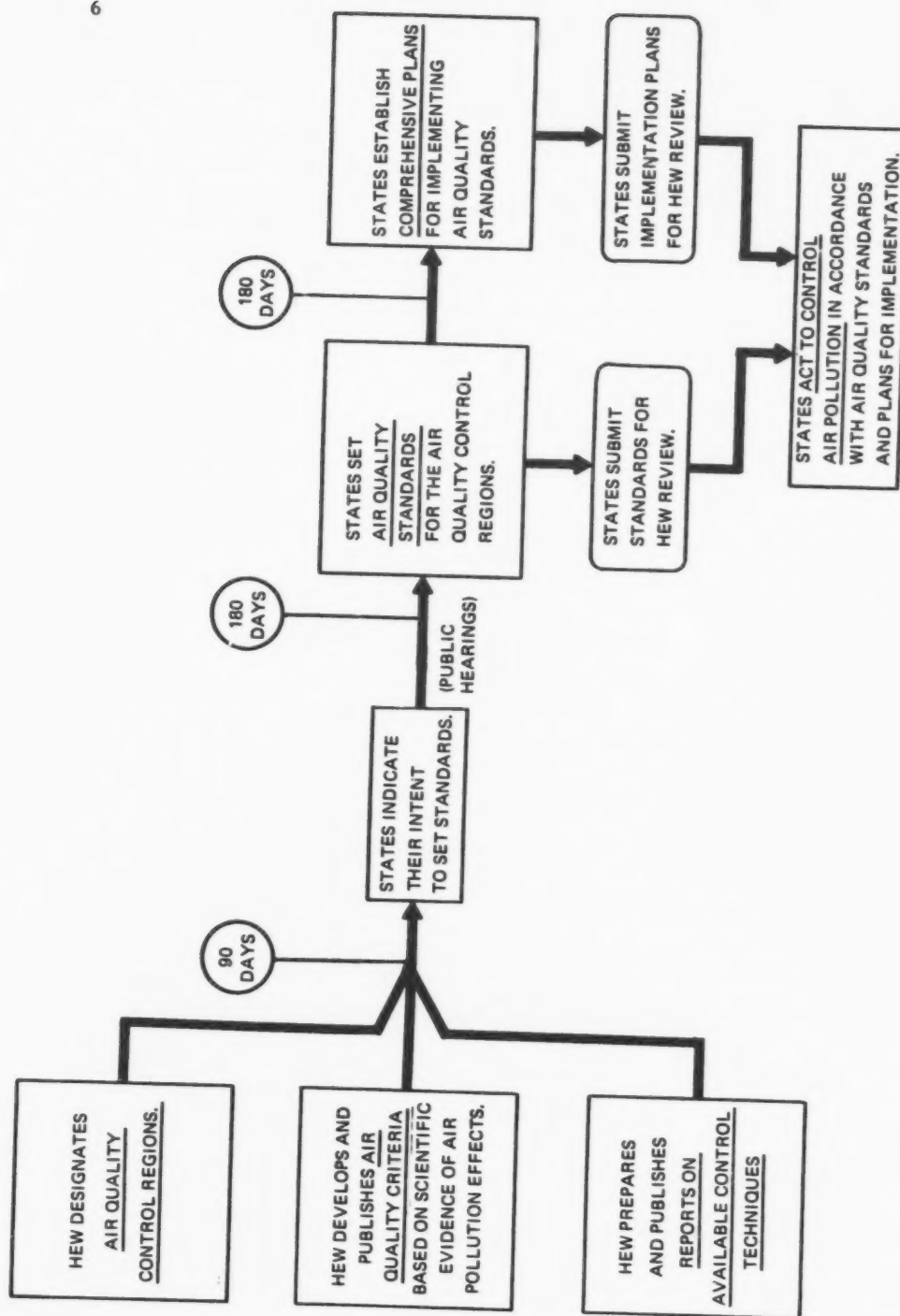


Figure 1 FLOW DIAGRAM FOR ACTION TO CONTROL AIR POLLUTION ON A REGIONAL BASIS, UNDER THE AIR QUALITY ACT.

when the Federal government designates air quality control region boundaries and publishes air quality criteria and information on available control techniques. Following the completion of these steps, the Governor(s) of the State(s) involved in a region designation must file with the Secretary within 90 days a letter of intent, indicating that the State(s) will adopt within 180 days ambient air quality standards for the pollutants covered by the published criteria and control technology documents and adopt within an additional 180 days plans for the achievement and enforcement of those standards in the designated air quality control regions.

The new Federal legislation provides for a regional attack on air pollution and, at the same time, allows latitude in the forms which regional efforts may take. While the Secretary retains approval authority, the State(s) involved in a designated region assumes the responsibility for developing standards and an implementation plan which includes administrative procedures for abatement and control. For regions which extend across jurisdictional boundaries, informal cooperative arrangements may be adequate in some cases to insure compatible standards and enforcement among the jurisdictions. In other cases, more formal arrangements, such as interstate compacts, may be selected. The objective in each instance will be to provide effective mechanisms for control on a regional basis.

## THE SIZE OF A REGION

Several objectives are important in determining how large an air quality control region should be. Basically, these objectives can be divided into three separate categories. First, a region should be self-contained with respect to air pollution sources and receptors. In other words, a region should include most of the important sources in the area as well as most of the people and property affected by those sources. In this way, all the major elements of the regional problem will lie within one unified administrative jurisdiction. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important

influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative influence than short term data on episodic conditions.

The second general objective requires that region boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, region boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that region boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Air pollution is a regional problem which often extends across several municipal, county,

and even state boundaries. Clearly, the collaboration of several governmental jurisdictions is prerequisite to the solution of the problem. Therefore, the region should be delineated in a way which encourages regional cooperation among the various governmental bodies involved in air pollution control. In this regard, the existing pattern of governmental cooperation on the whole range of urban problems may become an important consideration. Certainly the pattern of cooperation among existing air pollution control programs is a relevant factor. In general, administrative considerations dictate that governmental jurisdictions should not be divided. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

#### PROCEDURE FOR DESIGNATION OF REGIONS

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration for designating air quality control regions.

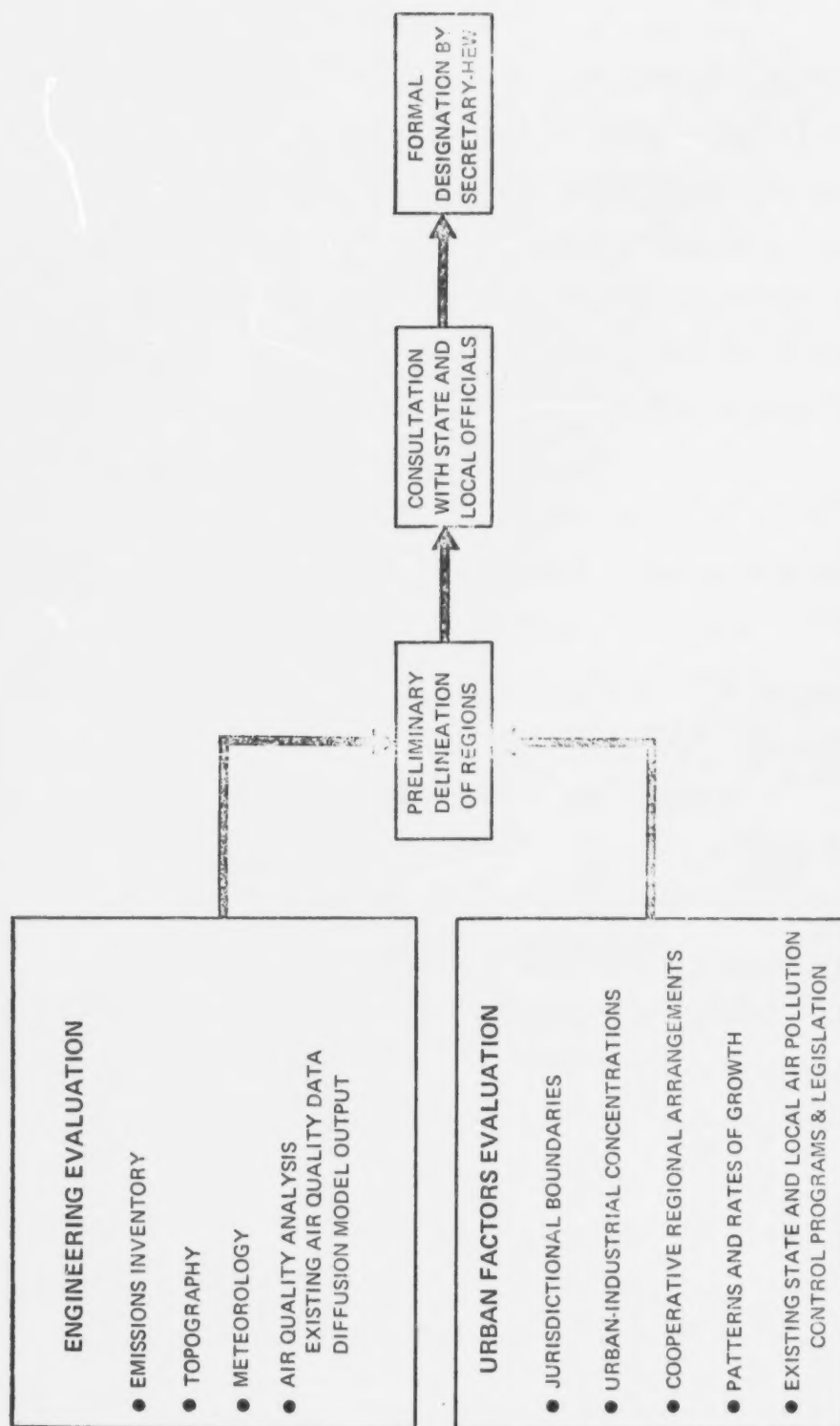


Figure 2. FLOW DIAGRAM FOR THE DESIGNATION OF AIR QUALITY CONTROL REGIONS.

A preliminary delineation of the region is developed by bringing together two essentially separate studies--"Evaluation of Engineering Factors," and the "Evaluation of Urban Factors."

The study of "Engineering Factors" indicates the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are located by taking an inventory of emissions from automobiles, industrial activities, space heating, waste disposal, and other pollution generators. Pollution concentrations in the ambient air are estimated from both air quality sampling data and a theoretical diffusion model. When it exists, air quality sampling data is more reliable than the theoretical diffusion model results since the data is directly recorded by pollution measuring instruments. Unfortunately, in many cases air quality sampling data is available for only one or two pollutants measured at an insufficient number of locations and during an insufficient length of time. The theoretical model is used to supplement inadequate air quality sampling data. As a whole, the engineering study indicates how large the air quality control region must be in order to encompass most pollution sources and most people and property affected by those sources.

The study of "Urban Factors" encompasses non-engineering considerations. It reviews existing governmental jurisdictions, current air pollution control programs, present concentrations of population

and industry, and expected patterns of urban growth. Other non-engineering factors are discussed when they are relevant. As a whole, the study of urban factors indicates how large an air quality control region must be in order to encompass expected growth of the pollution problem in the future. It also considers which group of governmental jurisdictions will most effectively administer a strong regional air quality control program.

The conclusions of the engineering study are combined with the results of the urban factors study to form the basis of an initial proposal for an air quality control region. As shown in Figure 2, the proposal is then submitted for consultation with State and local officials. After reviewing the suggestions raised during the consultation, the Secretary formally designates the region with a notice in the Federal Register and notifies the governors of the States affected by the designation.

The body of this report contains a proposal for the boundaries of the Louisville Interstate Air Quality Control Region and supporting studies on engineering and urban factors. The report itself is intended to serve as the background document for the formal consultation with appropriate State and local authorities.

## EVALUATION OF URBAN FACTORS

### INTRODUCTION

A number of urban factors are relevant to the problem of defining air quality control region boundaries. First, the location of population is an important consideration, since human activity is the primary cause of air pollution, and humans are the ultimate victims. The population growth pattern is another important consideration, since an air quality control region should be designed not only for the present but also for the future. The location of industrial activity and the industrial growth pattern are relevant considerations for similar reasons. Political and jurisdictional considerations are important, since the Clean Air Act envisions regional air pollution programs based on cooperative efforts among many political jurisdictions. The following discussion of urban factors will present these considerations as they apply to the Louisville area.

### POPULATION

Figure 3 displays present population densities of fifteen counties in the Louisville area. These counties can be separated into three categories on the basis of population density. The category with the highest density, more than 1,000 residents per square mile, contains only Jefferson County, Kentucky, which includes the City of Louisville. The category with moderate population densities, from 100 to 1,000 residents per square mile, contains

FIGURE 3. 1969 POPULATION DENSITY

Residents Per Square Mile



three counties; Floyd and Clark in Indiana, and Hardin in Kentucky. The third category, with population densities less than 100 residents per square mile, contains the remaining counties shown in Figure 3.

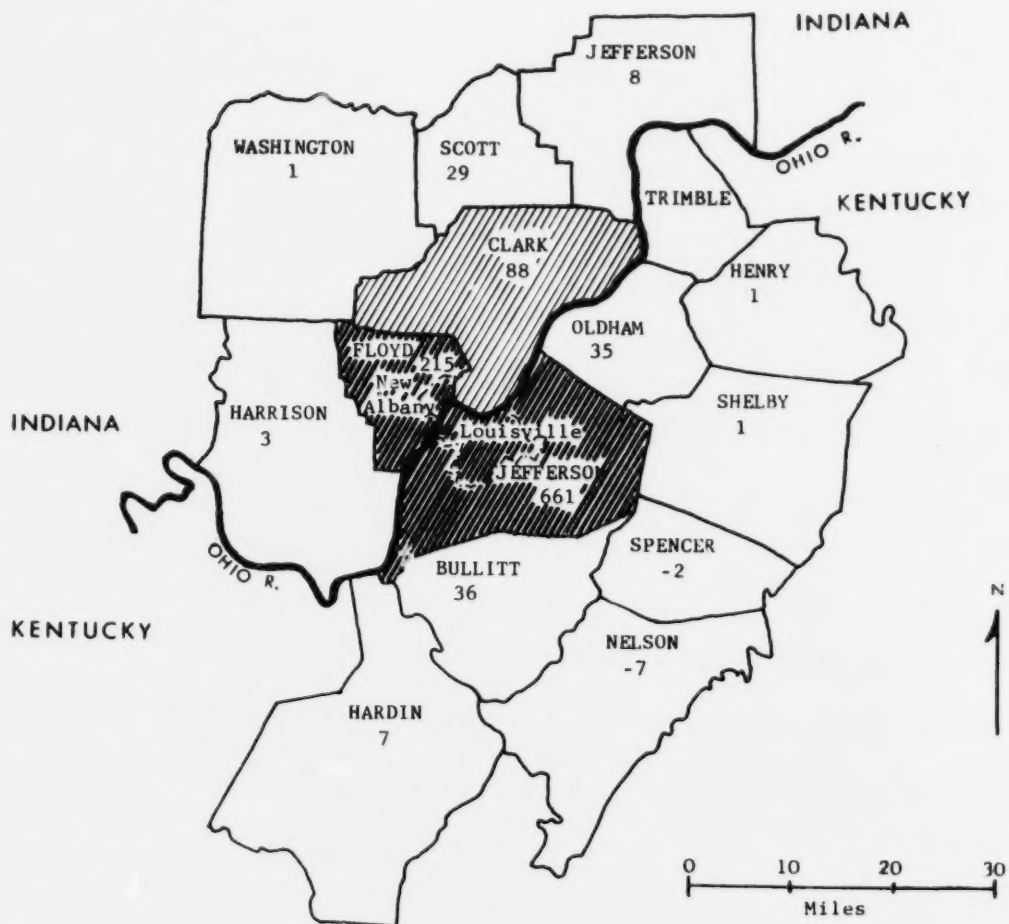
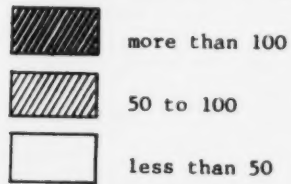
The Louisville Standard Metropolitan Statistical Area (SMSA) is composed of three counties; Jefferson in Kentucky, and Floyd and Clark in Indiana. These three counties contain about 800,000 residents, who constitute approximately 75% of the total population of all fifteen counties in Figure 3. The SMSA embraces the major urbanized portions of the Louisville region. It reflects the close economic and social links which exist between Louisville and Floyd and Clark Counties, directly across the Ohio River.

Oldham and Bullitt Counties lie adjacent to the northeastern and southern borders of Jefferson County, less than 15 miles from downtown Louisville. However, neither of these counties has become urbanized to a significant degree by population spreading outward from Louisville. At the present time, Oldham and Bullitt Counties together contain only about 3% of the total population of the fifteen counties shown in Figure 3.

A number of separate organizations have studied the potential for population growth in the Louisville area during the next decade (1,2,3,4,5,6). Although the specific estimates of population growth vary from study to study, the data displayed in Figure 4 can be considered representative of the various estimates. There appears to be general agreement that the bulk of the population growth will

FIGURE 4. POPULATION GROWTH, 1969-1980

Additional Residents Per Square Mile



occur in the three counties which constitute the Louisville SMSA. Portions of Jefferson County outside of the City of Louisville are expected to experience the greatest amount of residential development during the next decade. Floyd and Clark County are also expected to be affected by population spreading outward from the urban center along expressways I 64 and I 65 north of Louisville (see Figure 5). Together, these three counties may have 300,000 additional residents by 1980.

In contrast, surrounding counties are expected to experience limited population growth, or even population decrease. Among these counties, Oldham and Bullitt are the most likely to register population growth due to their proximity to Louisville. Expressways I 71 and I 65 will promote residential development in Bullitt and Oldham by decreasing the commuting time to Louisville. Even at the present time residential development along these traffic corridors has spread past the Jefferson County boundary. Nevertheless, population growth in Oldham and Bullitt Counties is likely to be gradual rather than precipitous as long as undeveloped land still remains in Jefferson, Floyd, and Clark Counties. Figure 4 indicates that other counties in the Louisville area are unlikely to register significant population growth.

#### MANUFACTURING ACTIVITY

One method for determining the location of manufacturing

FIGURE 5. MAJOR HIGHWAYS IN THE LOUISVILLE AREA



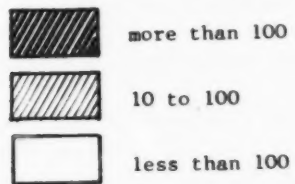
activity is based on the number of people employed in manufacturing firms. Figure 6, which uses 1963 employment data, indicates the density of manufacturing employment on a county-wide scale. Jefferson County had by far the most dense concentration of manufacturing employment, and accounted for nearly 80 percent of the total manufacturing employment of all fifteen counties shown in Figure 6. Floyd and Clark Counties contained another ten percent of the total manufacturing employment. Other Counties in the area had relatively low levels of manufacturing activity.

Employment data from 1967 (3) indicates that the largest segment of manufacturing employment, nearly 25 percent, was engaged in the production of machinery. The next largest segment, somewhat more than 10 percent, was engaged in the production of food and kindred products. The third largest segment, approximately 10 percent, was engaged in the production of chemicals, rubber, and plastic. Ordnance, fabricated metals, and primary metals each accounted for a significant portion of manufacturing employment, although less than 10 percent in each category. From 1951 to 1967, machinery and ordnance production registered the largest increase of all categories of manufacturing employment.

Manufacturing employment in Jefferson, Floyd, and Clark is expected to grow from about 106,000 employees in 1967 to about 128,000 employees in 1980. About one-third of the growth is expected to take place in the two Indiana Counties, thereby promoting the present tendency for decentralization of manufacturing

FIGURE 6. MANUFACTURING EMPLOYMENT DENSITY, 1963

Employees Per Square Mile



employment from the urban core.

Counties surrounding the Louisville SMSA are not expected to register dramatic growth in manufacturing employment during the next decade. Residential developments may appear in Oldham and Bullitt Counties in conjunction with new manufacturing plants, such as the new Ford Truck assembly plant, located along the outer fringe of Jefferson County. But the development of heavy manufacturing plants in Oldham and Bullitt is not anticipated in the near future.

#### EXISTING AIR POLLUTION CONTROL PROGRAMS

In the Commonwealth of Kentucky, responsibility for air pollution control rests with the Air Pollution Control Commission. The Commission has authority to set statewide ambient air quality standards and emission standards. The Commission also has authority to establish local standards more stringent than the statewide standards when local conditions warrant such control. At the present time, the Commission has adopted regulations which require registration of air pollution sources, prohibit open burning, and control air pollution from incineration, tepee waste burning, and coal refuse disposal. Two more regulations are under consideration which would control particulate pollution from combustion sources and require operation permits for air pollution sources. The annual budget of the Kentucky air pollution control program is about 450,000 dollars.

Kentucky Statutes specifically allow the Commission to cede its jurisdiction to a county air pollution control program if, after review, the Commission finds the county program to be satisfactory. The Commission is authorized to recover its jurisdiction whenever it believes the county program is failing to meet state standards. During January, 1968, the Commission authorized the Louisville and Jefferson County Air Pollution Control Board to undertake air pollution control responsibilities within the City of Louisville and Jefferson County. The City-County program has an annual budget of about 245,000 dollars. Regulations adopted by the Board deal primarily with particulate pollution from specific types of sources such as grain handling, open burning, cupola operations, and process dust. The Board is presently considering a regulation to control sulfur oxides emissions and is expanding its air monitoring network.

The Indiana Air Pollution Control Board, established in 1961, has basic statewide responsibility for all pollution control in Indiana. Recent amendments to Indiana Statutes authorize the Board to establish air quality basins and to adopt ambient air quality standards for those basins. Local air pollution control programs are authorized to adopt and enforce local ordinances which are consistent with the provisions of the State program. Furthermore, cities and counties may join with other cities and counties to

administer a cooperative air pollution control program. At the present time, none of the cities or counties in the Indiana portion of the Louisville area conducts an air pollution control program.

#### REGIONAL PLANNING IN THE LOUISVILLE AREA

The Falls of the Ohio Metropolitan Council of Governments conducts regional planning activities for three counties; Jefferson, Floyd, and Clark. The annual budget of the Council of Governments (COG) is about 200,000 dollars. Established in 1966, the COG has a Board which contains six representatives from Kentucky and six representatives from Indiana. Metropolitan Coordinating Committees have been created within the COG to deal with planning of open space and parks, transportation, water supply and sewers, and solid waste disposal. Recent activities of the COG have included studies of land use, the regional economy, rapid transit, housing, open space, and airport location. The COG has also been working on a project to promote coordination and cooperation among the police systems in the metropolitan area and to design an advanced data and communications system for the joint use of the police systems.

Many of the COG studies are produced in conjunction with and under contract with the planning agencies of the three counties in the COG jurisdiction. The Louisville and Jefferson County Planning Commission has a staff of about 50 people and has been

responsible for planning activities throughout Jefferson County for a number of years. The Clark County Regional Planning Board is composed of a representative from each of five zoning areas within the County, and has about three staff members. Floyd County has two planning commissions, one for the City of New Albany, and one for the remainder of the County. These two planning commissions have a staff of about five planners.

#### SUMMARY

At the present time more than 800,000 people live in the Louisville SMSA, composed of Jefferson, Floyd, and Clark Counties. Thus, the SMSA contains approximately 75 percent of the total population of the fifteen counties in the study area. In addition, the SMSA contains essentially all of the urbanized portions of the Louisville area. Although Oldham and Bullitt Counties are less than 15 miles from downtown Louisville and are connected to Louisville by expressways, neither of these counties is urbanized to a significant degree at the present time.

Various studies have predicted that the bulk of population growth during the next decade in the Louisville area will occur in the three counties of the SMSA. Together, these three counties may gain 300,000 residents from 1970 to 1980. In contrast, surrounding counties are expected to record slight population growth, or even population decrease.

At the present time, the bulk of manufacturing activity is located in Jefferson County. About 80 percent of the total manufacturing employment of the fifteen county study area works in Jefferson County. The next decade is expected to witness the relocation of light and "sophisticated" industry to the fringes of the urban core. For this reason, Floyd and Clark Counties may experience considerable development of light industry by 1980. However, similar development is not expected to extend into Oldham and Bullitt Counties during the near future.

The Falls of the Ohio Metropolitan Council of Governments conducts regional planning activities for three counties: Jefferson, Floyd, and Clark. The planning activities include studies on solid waste disposal, water supply, and sewers; subjects which are related to air pollution control.

In conclusion, the evaluation of urban factors indicates that the Louisville Air Quality Control Region should include at least three counties: Jefferson, Clark and Floyd.

## EVALUATION OF ENGINEERING FACTORS

### INTRODUCTION

A study of the technical aspects of air pollution in the Louisville area was based on consideration of pollutant emissions, topography, meteorology, and theoretical and measured air quality.

### EMISSIONS INVENTORY

An emissions inventory is a quantitative description of emission sources broken down by geographic location and each type of pollutant. The inventory usually identifies the "core" of an air quality control region -- that is, the area where the bulk of the emissions occur and throughout which control activities must take place in order to deal with a regional air pollution problem. For this reason, a presentation of the emissions inventory serves as a logical starting point in the engineering evaluation.

The National Air Pollution Control Administration conducted an inventory of air pollutant emissions for the Louisville area. The inventory was based on estimated rather than measured emissions. Three major pollutants -- sulfur oxides, particulates, and carbon monoxide -- were considered in this study since emissions of these pollutants provide a general measure of the location and density of air pollution sources in the Louisville area. Emissions from thirty major point sources (sources emitting more than one ton

of any pollutant per day) were specifically listed in the inventory. The inventory encompassed five counties; Jefferson, Oldham, and Bullitt in Kentucky, and Floyd and Clark in Indiana. This area was divided into the grid system shown in Figure 7. The estimated emissions of each of the three pollutants were expressed by grid zone as average daily emissions on the basis on an annual averaging time. Table I shows the annual-average daily emissions.

Emissions densities for each of the three pollutants, expressed in tons per square mile per day, were determined by relating the total emissions in each of the grid zones to the land area of that zone. Figures 8, 9, and 10 show the resulting densities on maps. Where point sources are responsible for more than 50% of the emissions in a grid zone, this fact is indicated in Table I and the Figures. Figure 11 shows the relative contribution of the various counties and various source categories to the total emissions of each pollutant.

#### Sulfur Oxides Emissions:

Figure 8 indicates that the most dense concentrations of sulfur oxides emissions occur along the Ohio River in western portions of Louisville and Jefferson County, and in southern portions of Floyd County. High emission densities occur throughout Louisville. About 65 percent of sulfur oxides emissions are from sources in Jefferson County, 28 percent from

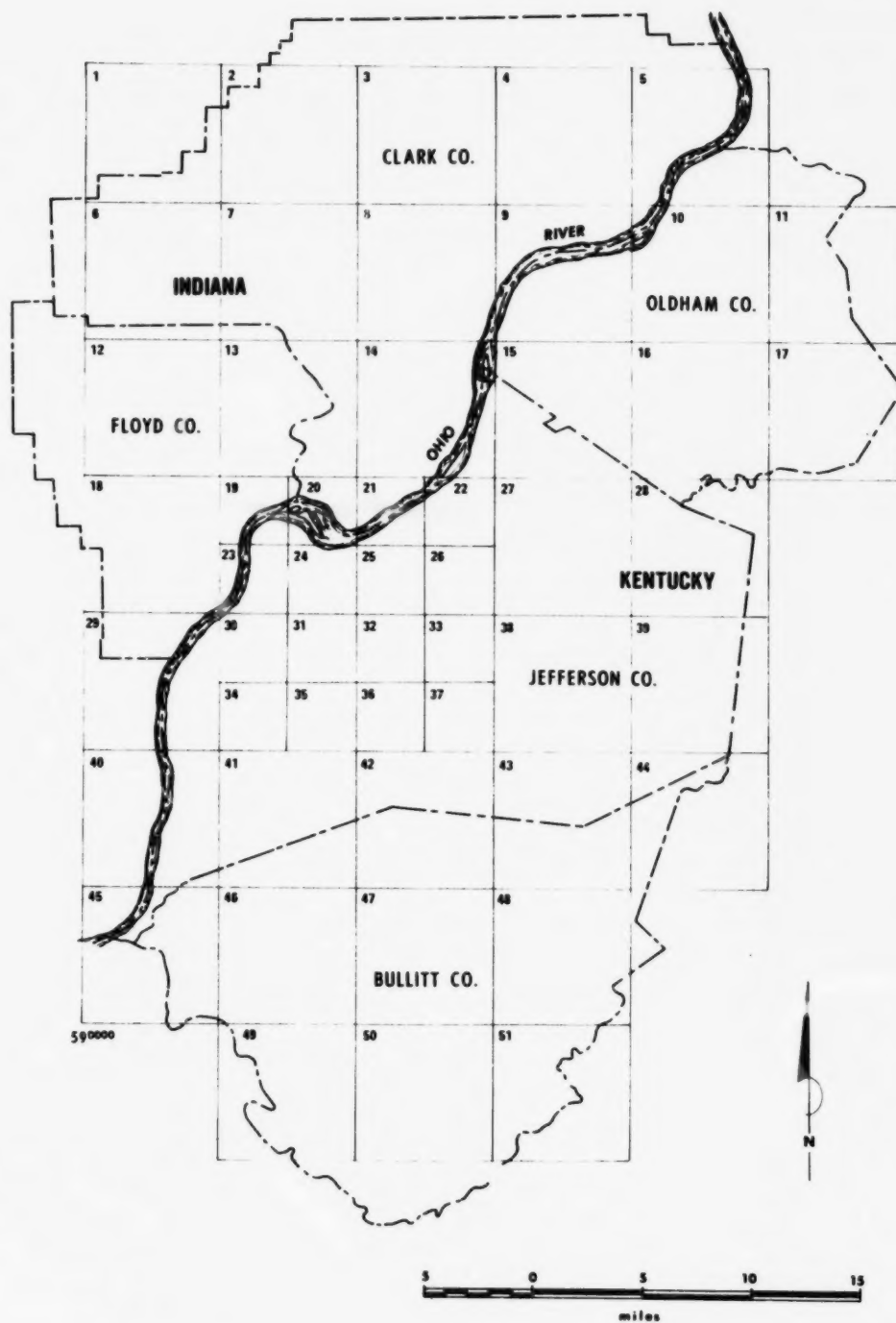


Figure 7;  
EMISSIONS INVENTORY GRID SYSTEM

Table I  
LOUISVILLE EMISSIONS INVENTORY

Tons Per Day

| <u>Grid<br/>Number</u> | <u>Sulfur<br/>Oxide<br/>Emissions</u> | <u>Particulate<br/>Emissions</u> | <u>Carbon<br/>Monoxide<br/>Emissions</u> |
|------------------------|---------------------------------------|----------------------------------|------------------------------------------|
| 1                      | 0.1                                   | --                               | 0.2                                      |
| 2                      | 0.1                                   | 0.1                              | 3.7                                      |
| 3                      | 0.1                                   | --                               | 0.6                                      |
| 4                      | 0.1                                   | --                               | 0.2                                      |
| 5                      | 0.1                                   | --                               | 0.4                                      |
| 6                      | 0.1                                   | --                               | 0.5                                      |
| 7                      | 0.2                                   | 4.6*                             | 5.3                                      |
| 8                      | 1.2                                   | 0.6                              | 4.9                                      |
| 9                      | 0.5                                   | 0.3                              | 3.2                                      |
| 10                     | 2.9*                                  | 1.7*                             | 5.0                                      |
| 11                     | 0.4                                   | 0.2                              | 5.3                                      |
| 12                     | 0.4                                   | 0.1                              | 1.9                                      |
| 13                     | 4.2                                   | 2.2                              | 29.4                                     |
| 14                     | 23.9*                                 | 29.9*                            | 5.7                                      |
| 15                     | 2.5*                                  | 2.0*                             | 11.0                                     |
| 16                     | 1.6                                   | 1.1                              | 3.9                                      |
| 17                     | 0.1                                   | --                               | 0.4                                      |
| 18                     | 0.3                                   | 0.1                              | 1.7                                      |
| 19                     | 236.4*                                | 221.6*                           | 40.5                                     |
| 20                     | 12.1*                                 | 3.7                              | 59.2                                     |
| 21                     | 6.2                                   | 4.1                              | 33.0                                     |
| 22                     | 2.2                                   | 1.6                              | 5.1                                      |
| 23                     | 106.9*                                | 20.4*                            | 46.0                                     |
| 24                     | 40.5*                                 | 25.1*                            | 78.1                                     |
| 25                     | 3.4                                   | 2.2                              | 34.7                                     |
| 26                     | 1.4                                   | 1.1                              | 33.0                                     |
| 27                     | 1.4                                   | 1.0                              | 37.1                                     |
| 28                     | 0.9                                   | 0.6                              | 9.3                                      |
| 29                     | 289.3*                                | 11.1*                            | 8.3                                      |
| 30                     | 35.3*                                 | 4.8                              | 18.6                                     |

\* Indicates that more than 50% of the emissions in the grid zone are due to point sources.

| <u>Grid<br/>Number</u> | <u>Sulfur<br/>Oxide<br/>Emissions</u> | <u>Particulate<br/>Emissions</u> | <u>Carbon<br/>Monoxide<br/>Emissions</u> |
|------------------------|---------------------------------------|----------------------------------|------------------------------------------|
| 31                     | 8.7                                   | 7.3                              | 49.7                                     |
| 32                     | 10.4*                                 | 5.2                              | 75.4                                     |
| 33                     | 23.4*                                 | 3.6                              | 38.8                                     |
| 34                     | 1.1                                   | 0.9                              | 23.2                                     |
| 35                     | 1.5                                   | 1.0                              | 17.6                                     |
| 36                     | 1.4                                   | 1.0                              | 16.2                                     |
| 37                     | 0.2                                   | 0.3                              | 14.2                                     |
| 38                     | 0.5                                   | 0.4                              | 17.3                                     |
| 39                     | 0.1                                   | --                               | 1.9                                      |
| 40                     | 0.4                                   | 0.4                              | 22.9                                     |
| 41                     | 0.4                                   | 0.3                              | 8.1                                      |
| 42                     | 2.9                                   | 3.9                              | 19.3                                     |
| 43                     | 2.6                                   | 2.0                              | 8.2                                      |
| 44                     | 0.1                                   | --                               | 1.1                                      |
| 45                     | 1.0                                   | 12.3*                            | 0.2                                      |
| 46                     | --                                    | --                               | 0.4                                      |
| 47                     | 3.4                                   | 2.5                              | 7.2                                      |
| 48                     | 0.1                                   | 0.1                              | 0.6                                      |
| 49                     | --                                    | --                               | 0.1                                      |
| 50                     | 3.0*                                  | 1.0*                             | 5.1                                      |
| 51                     | --                                    | --                               | 0.3                                      |

\* Indicates that more than 50% of the emissions in the grid zone are due to point sources.

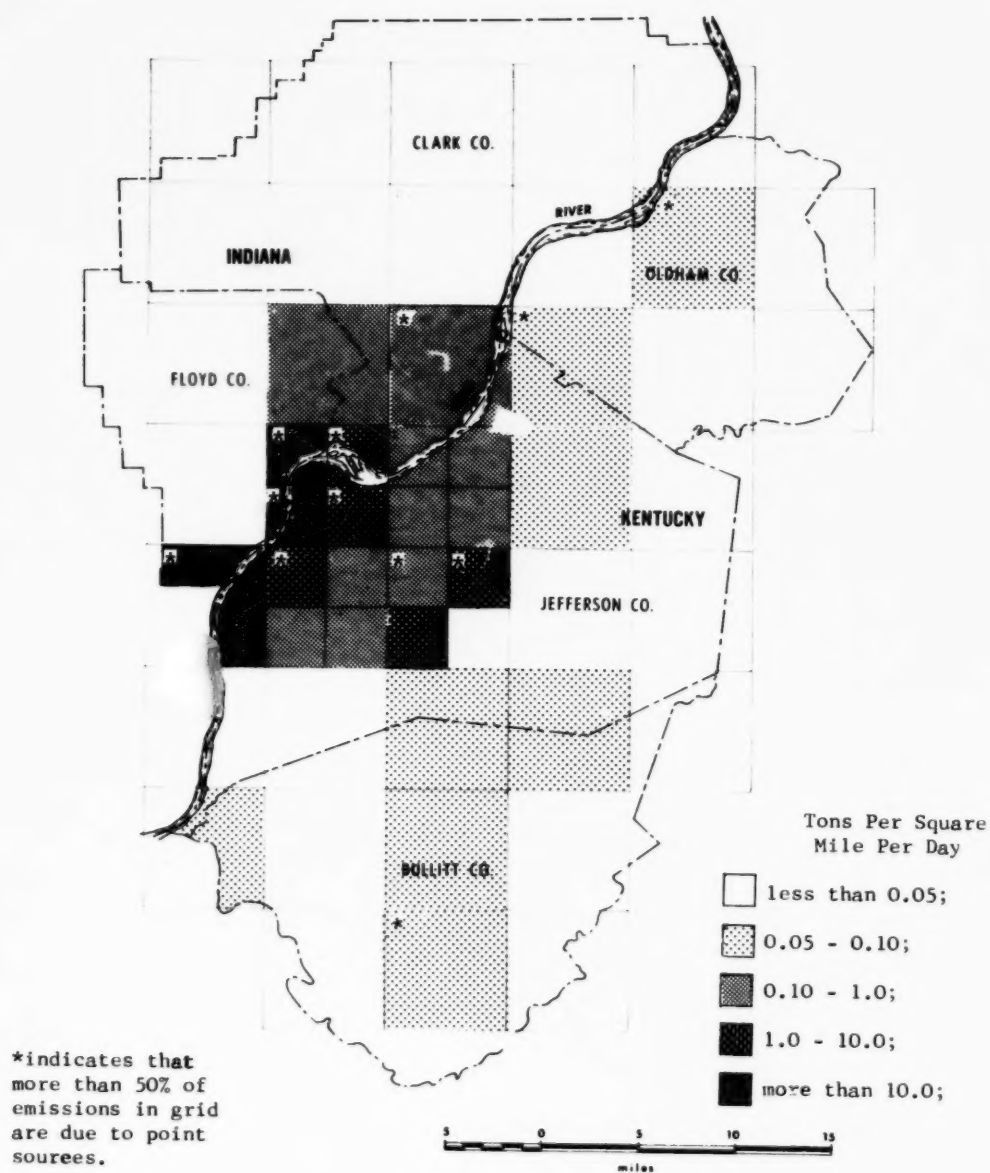


Figure 8;  
SULFUR OXIDES EMISSIONS

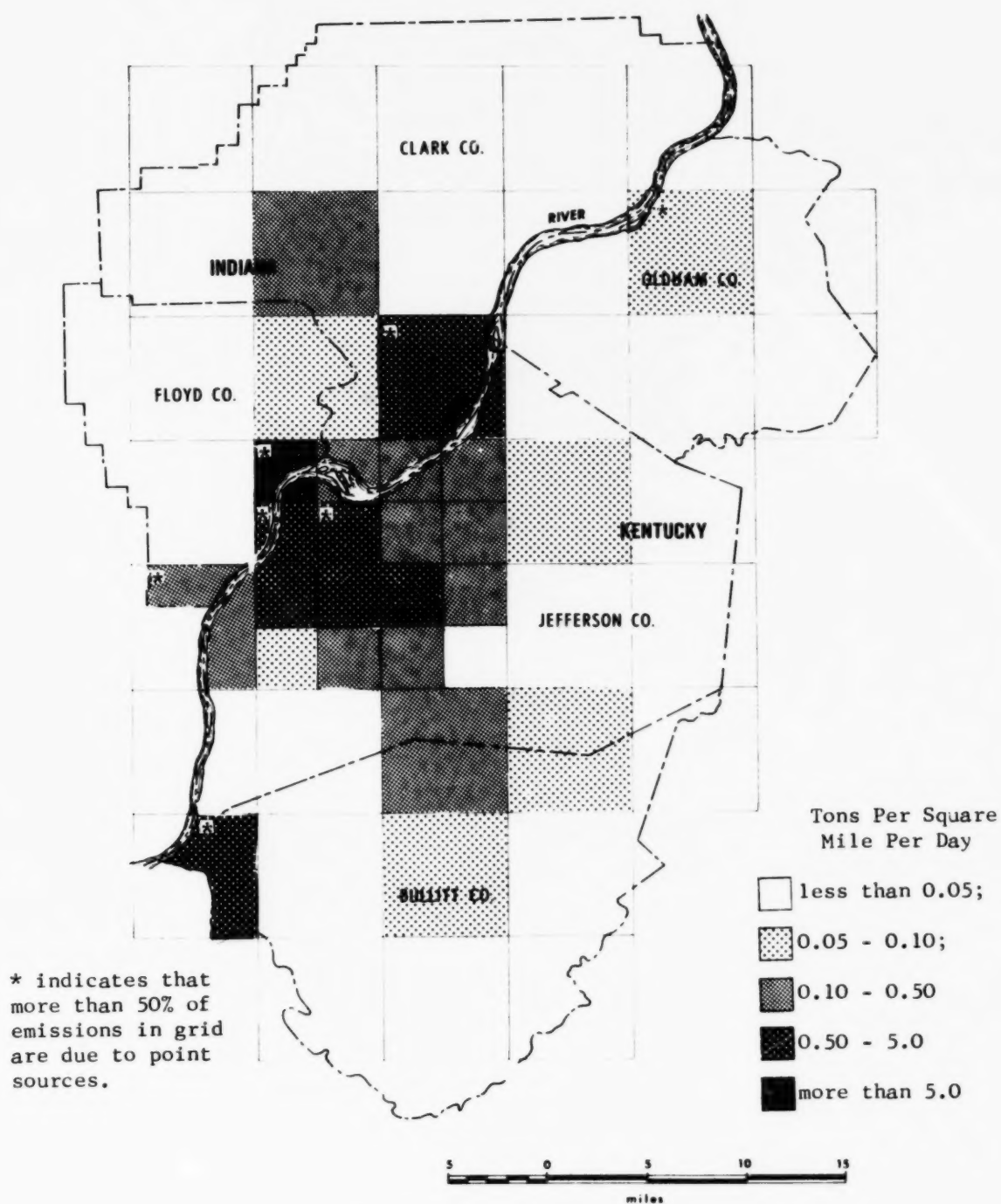


Figure 9:  
PARTICULATE EMISSIONS

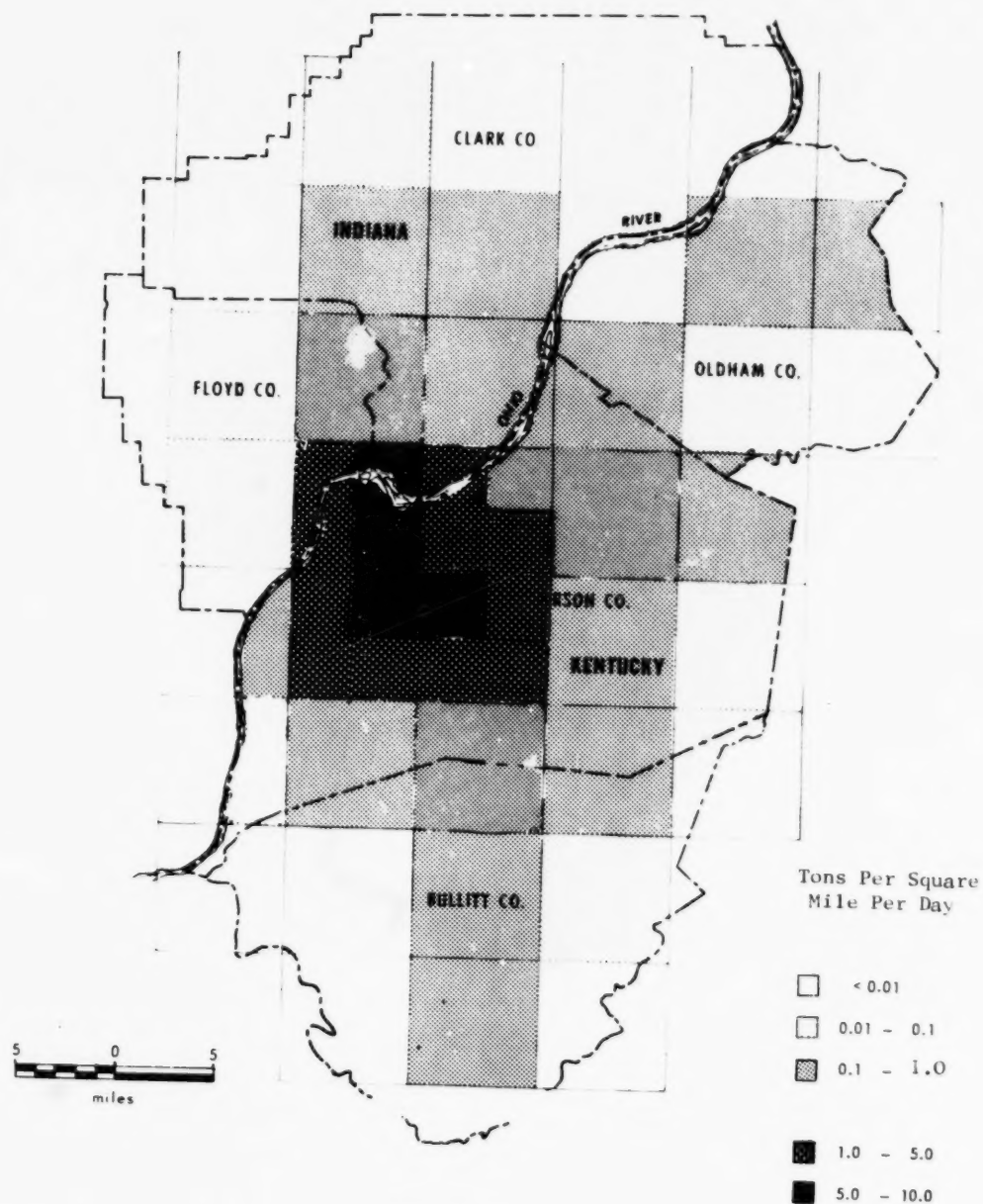
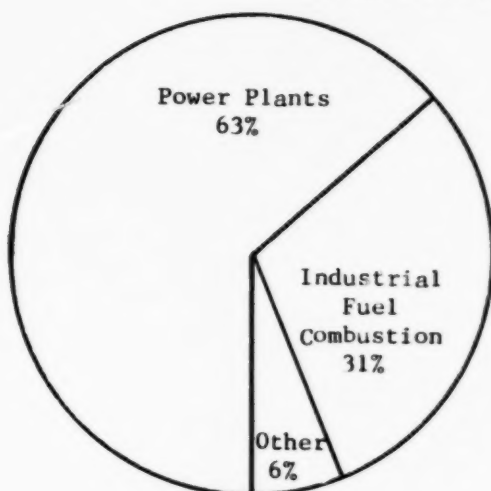


Figure 10:  
CARBON MONOXIDE EMISSIONS

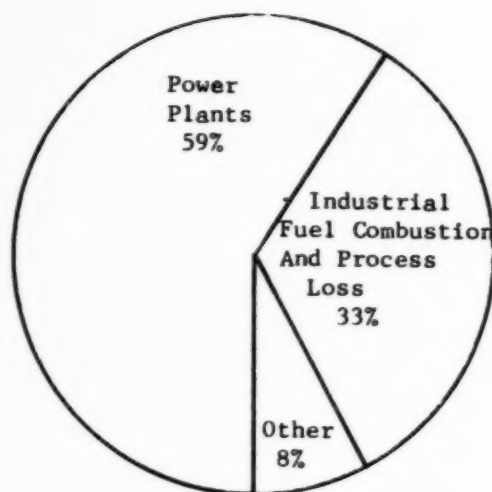
Figure 11:

35

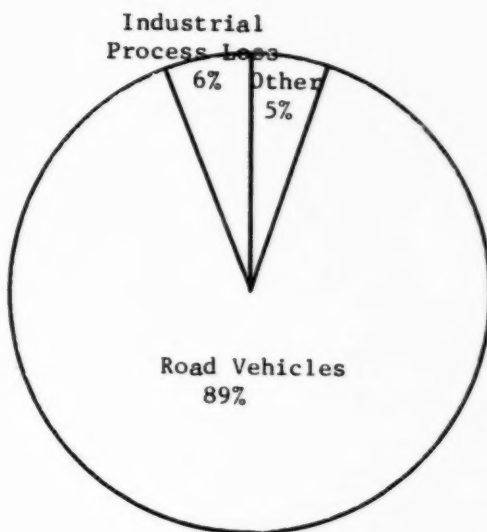
PERCENT CONTRIBUTION TO EMISSIONS  
BY SOURCE CATEGORIES



SULFUR OXIDES

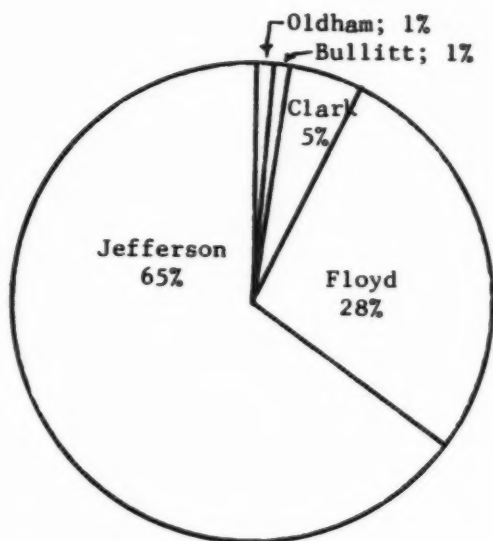


PARTICULATES

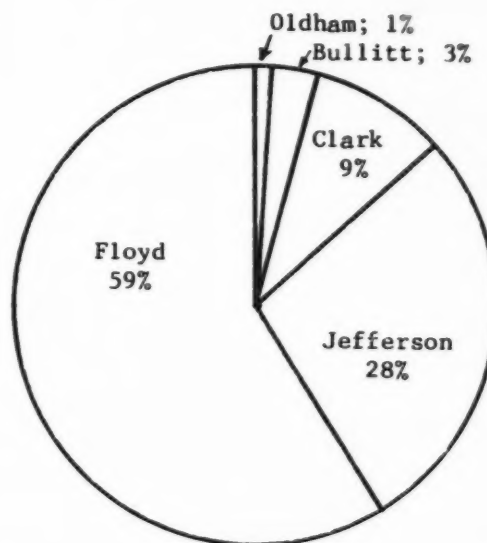


CARBON MONOXIDE

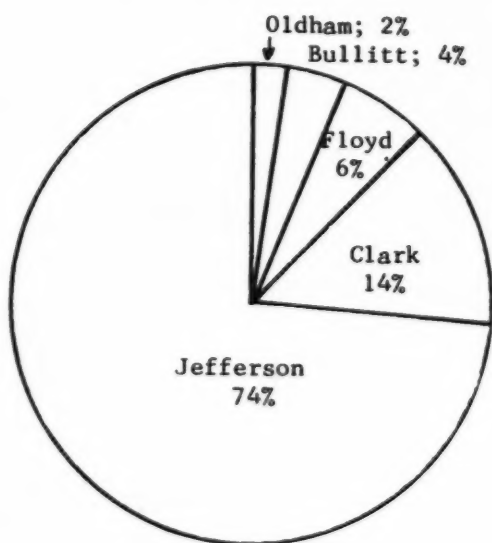
Figure 11, Continued

PERCENT CONTRIBUTION TO EMISSIONS  
BY COUNTIES

SULFUR OXIDES



PARTICULATES



CARBON MONOXIDE

sources in Floyd County, and 5 percent from sources in Clark County. Oldham and Bullitt together contribute only 2 percent of the sulfur oxide emissions. Power plants and industrial fuel combustion account for about 94 percent of the sulfur oxides emissions.

#### Particulate Emissions:

Figure 9 shows that particulate emissions are most densely concentrated in southern portions of Floyd County and western portions of Louisville and Jefferson County. The density of particulate emissions is high also in Clark County south of Charlestown. Floyd County is by far the largest contributor to particulate emissions, due to the power plant located along the Ohio River in the southern section of New Albany. About 59 percent of the particulates reported in the emissions inventory came from sources in Floyd, whereas only 28 percent came from sources in Jefferson, and only 9 percent from sources in Clark. Oldham and Bullitt Counties together added only 4 percent. Power plants were responsible for nearly 60 percent of the particulate emissions, and industrial fuel combustion accounted for most of the remainder.

#### Carbon Monoxide Emissions:

Figure 10 shows that carbon monoxide emissions are more evenly spread throughout the Louisville Metropolitan area than

particulate and sulfur oxide emissions. The most dense emissions are located in downtown Louisville, where automotive traffic is most concentrated. The effect of Interstate Highway 65 is apparent in the emission density in grid zones extending to the south of Louisville along the path of the highway. Jefferson County is the location of about 74 percent of carbon monoxide emissions, Clark about 14 percent, and Floyd about 6 percent. About 90 percent of carbon monoxide emissions are due to road vehicles.

#### Summary of Emissions Inventory:

The emissions inventory encompassed five counties: Jefferson, Oldham, Bullitt, Floyd, and Clark. Essentially all of the emissions reported in the inventory occurred in three counties: Jefferson, Floyd, and Clark. At the present time Oldham and Bullitt Counties are not the location of significant sources of air pollutants. Thus, Jefferson, Floyd, and Clark Counties encompass the core of the Louisville regional air pollution problem.

#### TOPOGRAPHY

In general, the topography of the Louisville area does not contain striking features which have a large impact upon the transport of air pollution. The Ohio River Valley at Louisville is neither deep nor narrow, and therefore the channel effect of the valley is not as pronounced at Louisville as at some other cities along the Ohio River. Western portions of

Jefferson County are generally flat, whereas Floyd County, Clark County, and eastern portions of Jefferson County are generally rolling and hilly.

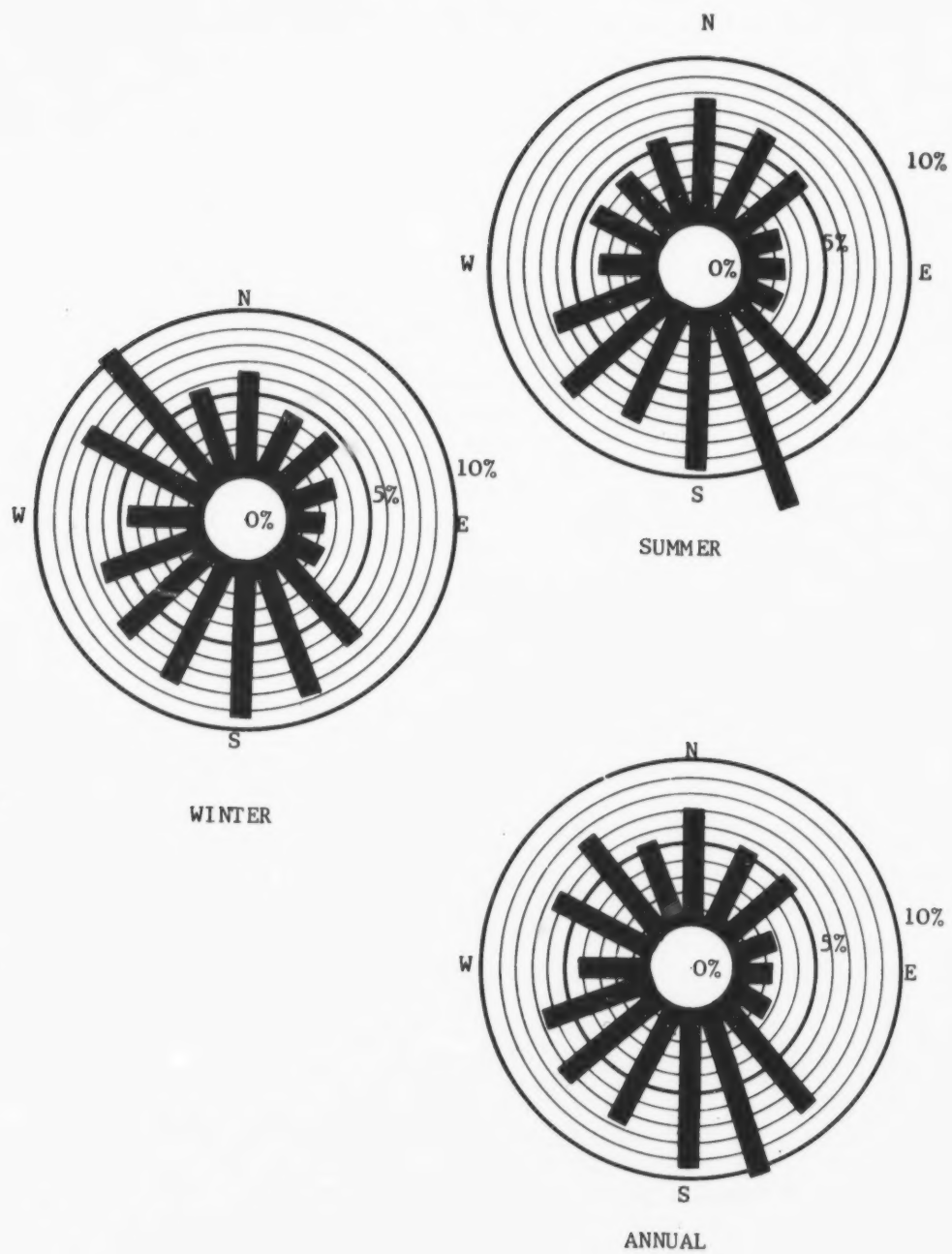
#### METEOROLOGY

Figure 12 shows the wind frequencies in the Louisville area averaged over the summer, winter, and annual time periods. During the summer, winds occur most frequently from the southern sector. About 45 percent of the time the wind is from a direction between southeast and southwest. Furthermore, the winds from the southern quadrant tend to have a higher speed than winds from other directions. The average wind speed during the summer is about 6 miles per hour. During the winter, winds are most frequent from the southern quadrant and from the northwest. As during the summer, winds from these directions tend to have greater speed than winds from other directions. The average wind speed during the winter is somewhat higher than that of the summer, about 9 miles per hour. On an annual average, winds from the east are least frequent and winds from southern directions are most frequent. The average wind speed on an annual average is slightly less than 8 miles per hour.

#### AIR QUALITY ANALYSIS:

A study of measured and estimated air quality is useful in determining the area affected by pollution sources and thus

Figure 12:  
WIND FREQUENCY, LOUISVILLE:



subject to inclusion in the air quality control region. Such a study can be based directly on air quality sampling data in those instances where the sampling program covers a large enough area and has been in existence long enough to provide reliable patterns of air quality throughout the region under study. Measured air quality data can be supplemented by estimated theoretical air quality data derived from a diffusion model using information on the location and quantity of pollutant emissions and on meteorological conditions. In the Louisville area, suspended particulates have been measured by high volume samplers during six months of 1969 at seven stations throughout Jefferson County. Four additional stations measured suspended particulates during four months of 1969. Sulfur oxides have been measured at two stations, both within the City of Louisville, by a Thomas Autometer. Carbon Monoxide has been measured at one station by a Beckman infrared analyzer. Diffusion model estimates of pollutant concentrations were calculated on the basis of 1967 emissions data. The summer period yielded the highest estimated concentrations. Figure 13 presents the measured and estimated data for sulfur oxides, Figure 14 for suspended particulates, and Figure 15 for carbon monoxide.

#### Sulfur Oxides:

Measured concentrations of sulfur oxides are about one-half as high as estimated concentrations. Estimated concentrations indicate that peak values occur in western Louisville.

Figure 13:  
ESTIMATED AND MEASURED SULFUR OXIDES CONCENTRATIONS  
Parts Per Million

Measured: July, 1967;

A

A; 0.03 ppm

B; 0.05 ppm



Figure 14:

## MEASURED AND ESTIMATED PARTICULATE CONCENTRATIONS

Micrograms Per Cubic Meter

Measured: 6 months, 1969;

- a. 151
- b. 161
- c. 304
- d. 191
- e. 171
- f. 129
- g. 123
- h. 130



Figure 15:  
MEASURED AND ESTIMATED CARBON MONOXIDE CONCENTRATIONS  
Parts Per Million

Measured: July, 1967

A. 5.0 ppm



The iso-concentration contour of 0.01 parts per million sulfur oxides (28 micrograms per cubic meter) is an acceptable indication of the extent of significant sulfur oxide pollution. Figure 13 indicates that this contour encompasses parts of Floyd, Jefferson, Clark, and Harrison Counties.

#### Particulates:

Measured concentrations of suspended particulates are generally higher than estimated concentrations, sometimes by a factor of two or more. The highest measured concentrations were reported in western Louisville at 304 micrograms per cubic meter averaged over a six month time period. These peak concentrations are expected to decrease in the future since the carbide plant recently converted to new furnaces and since other major point sources in the area are expected to install improved emission controls. The 60 microgram per cubic meter contour in Figure 14 can be considered an indication of the extent of significant particulate pollution in the Louisville area. This contour embraces most of Floyd County, about one-half of Jefferson County, and about one-third of Clark County. Surrounding counties appear to be affected to only a small degree by particulates from the urban core area.

#### Carbon Monoxide:

Measured concentrations of carbon monoxide are more than ten times as large as estimated concentrations. Since carbon

monoxide has been measured at only one station and since a large discrepancy exists between the measured and estimated concentrations, the data available at this time does not yield a reliable indication of the geographic extent of carbon monoxide pollution.

**SUMMARY:**

The emissions inventory shows that sources in Jefferson, Floyd, and Clark Counties are responsible for about 95 percent of all air pollutant emissions reported in the study. Sources in Oldham and Bullitt Counties add to pollutant emissions only to a slight degree. The highest concentrations of emissions are found along the Ohio River in western portions of Louisville and Jefferson County and southern portions of Floyd County.

The air quality analysis shows that Jefferson, Floyd, and Clark Counties encompass the bulk of the area affected by poor air quality due to emissions from the urban core area.

Therefore, the evaluation of engineering factors indicates that at least three counties should be included in the Louisville Air Quality Control Region: Jefferson, Floyd, and Clark.

### THE PROPOSED REGION

#### PROPOSAL

Subject to the scheduled consultation, the Secretary, Department of Health, Education, and Welfare, proposes to designate an air quality control region for the Louisville area, consisting of the territory encompassed by the following jurisdictions:

In the State of Kentucky,

Jefferson County;

In the State of Indiana,

Clark County

Floyd County.

The boundaries of the proposed region are illustrated in Figure 16.

#### DISCUSSION OF THE PROPOSAL

To be successful, an air quality control region should meet three basic objectives, as discussed in the section entitled "The Size of a Region," page 8. First, a region should be self-contained with respect to air pollution sources and receptors. Second, a region should be designated to meet not only present conditions but also future conditions. Third, region boundaries should foster unified and cooperative governmental administration of the air resource throughout the region.

Figure 16:

## PROPOSED LOUISVILLE AIR QUALITY CONTROL REGION



The evaluation of urban factors indicates that the bulk of the population in the Louisville area resides in three counties; Jefferson, Clark, and Floyd. These three counties presently constitute the Louisville Standard Metropolitan Statistical Area, and form the membership of the Falls of the Ohio Metropolitan Council of Governments. They are the basis of regional planning activities. Jefferson County contains about 80 percent of the manufacturing employment of the Louisville area at the present time. During the next decade, growth of population and manufacturing employment is expected to occur primarily in Jefferson, Clark, and Floyd.

The engineering evaluation shows that the same three counties contain essentially all of the air pollutant emissions sources in the Louisville area, and encompass most of the area affected by poor air quality resulting from those emissions

Oldham and Bullitt Counties are less than 15 miles from downtown Louisville. Both of these counties are rural in nature at the present time, add very little to pollutant emissions in the area, and enjoy relatively good air quality. Although they are close to the urban center, these counties are not expected to experience dramatic growth in population or manufacturing activity during the near future. Therefore, the inclusion of these counties in the Louisville Air Quality Control Region is not necessary at this time in order to deal with the regional air pollution problem. However, urbanization of

Oldham and Bullitt Counties may occur sooner than expected. If this situation develops, the Louisville Region boundaries should be reviewed and expanded if changed conditions warrant such action.

The boundaries proposed in this report for the Louisville Interstate Air Quality Control Region are a starting point for discussion with State and local officials at the scheduled consultation.

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